CRYOMILLED ALUMINUM ALLOYS AND COMPONENTS EXTRUDED AND FORGED THEREFROM

CROSS-REFERENCE TO RELATED APPLICATIONS

now US Pat. 6,902,699,

This application is a continuation of U.S. Application No. 10/263,135 filed October 2, 2002, which is hereby incorporated herein in its entirety by reference.

11/14/07

FIELD OF THE INVENTION

The present invention relates to the production of high strength cryomilled aluminum alloys, and to the extrusion and forging of cryomilled aluminum alloys.

BACKGROUND OF THE INVENTION

The aerospace industry requires structural metals and alloys that provide maximum strength with minimum weight. Traditionally, these roles have been fulfilled by aluminum, titanium, and alloys thereof. However, as the performance demands of the industry have increased, previously known aluminum and titanium alloys have been pushed to the limits of their usefulness.

The operation of high performance rocket propulsion systems are particularly demanding on metallic components. Extruded and forged parts such as fuel turbopump impellers and other rotational components require high strength and low density, but also require adequate ductility and toughness. Furthermore, because the rotational components of liquid-fueled rocket engines are exposed to cryogenic liquids at very high pressure and low temperature, the rotational components must retain their high strength and ductility in an extremely cold environment.

In the past, high performance aluminum alloy components, such as those used in rocket propulsion systems, were strengthened through precipitation heat treatment, resulting in tensile strengths of up to 80 ksi. The heat treated aluminum parts remain adequate for most modern day propulsion systems but fall short of meeting the demands of today's high-performance rocket engines and other similarly demanding propulsion systems. The components formed by precipitation heat treatment are not particularly suited for use in extremely cold environments such as those temperatures found in liquid fuel rocket engines. Further, heat treatment introduces residual stress